May 2022
APPG AI Evidence Meeting

Artificial Intelligence, Climate Change & Sustainability

PARLIAMENTARY BRIEF

Artificial Intelligence, Climate Change & Sustainability *is a* Parliamentary Brief based upon the All-Party Parliamentary Group on Artificial Intelligence (APPG AI) Evidence Meeting held online on the 23rd May 2022.

This APPG AI is co-Chaired by **Stephen Metcalfe MP** and **Lord Clement-Jones CBE**.

We would like to express our appreciation to the following people for their oral evidence:

- **Dr. Anand Rao,** Global Artificial Intelligence Lead**, PWC**
- **Dr. Aidan O'Sullivan,** Associate Professor in Energy & Artificial Intelligence**, UCL Energy Institute /** co-Founder**, Carbon Re**
- **Diana Dimitrova,** Managing Director**, Boston Consulting Group**
- **Pete Clutton-Brock,** co-Founder**, Centre for AI & Climate**
- **Prof. Gavin Shaddick,** co-Director**, Joint Centre for Excellence in Environmental Intelligence / University of Exeter**

Big Innovation Centre is the appointed Secretariat for APPG AI

- CEO, **Professor Birgitte Andersen**
- Rapporteur, **George Farrer**

The video recording of the Evidence Meeting can be found on our websites.

www.biginnovationcentre.com | Email: info@biginnovationcentre.com | @BigInnovCentre

https://bicpavilion.com/wall/appg-artificial-intelligence |
Email: appg@biginnovationcentre.com | @APPG_AI

PARLIAMENTARY BRIEF

Artificial Intelligence, Climate Change & Sustainability

All Party Parliamentary Group on
Artificial Intelligence

APPG AI Sponsors

The Group supporters – British Standards Institution, Brunel University London, CMS Cameron McKenna Nabarro Olswang, Deloitte, Ernst & Young, Innovate UK – UKRI, Osborne Clarke, PwC, and Rialto – enable us to raise the ambition of what we can achieve.

Contents

1. Introduction

In this meeting, the APPG AI discussed issues surround Artificial Intelligence (AI), Climate Change and Sustainability. Use cases for AI have increased massively in recent years, and the potential good of AI has been applied to tackling some major issues facing the world today - notably, questions encompassing Climate Change and Sustainability. Critical questions faced at this evidence meeting include how AI and machine learning can be used for efficient energy use and the conservation of natural resources, additionally what the UK Government and companies can do more to implement AI in order to deal with Climate Change.

Climate Change and Sustainability is a hot-button topic all around the world, and especially in the UK following **2021 United Nations Climate Change Conference (COP26)**[1] held in Glasgow in Autumn 2021, which has meant a, justly, increased attention on Climate Change issues. Therefore, the APPG on AI considered how, and if, AI and machine learning can be used to help combat Climate Change with leading academics and industry experts in this field.

Main questions:

- *COP26 (2021 United Nations Climate Change Conference) six months on: Where are we now and how does (or should) AI and machine learning help in three areas:*
    - *Efficient energy use and clean power*
    - *Conservation of natural resources*
    - *Disaster resiliency.*
- *What are the international standards or collaborations in these areas and how can (or should) UK government and UK public limited companies contribute more?*

List of panellists:

- **Dr. Anand Rao,** Global Artificial Intelligence Lead, **PWC**
- **Dr. Aidan O'Sullivan,** Associate Professor in Energy & Artificial Intelligence**, UCL Energy Institute /** Co-Founder, **Carbon Re**
- **Diana Dimitrova,** Managing Director, **Boston Consulting Group**
- **Pete Clutton-Brock,** co-Founder, **Centre for AI & Climate**
- **Prof. Gavin Shaddick,** co-Director, **Joint Centre for Excellence in Environmental Intelligence / University of Exeter**

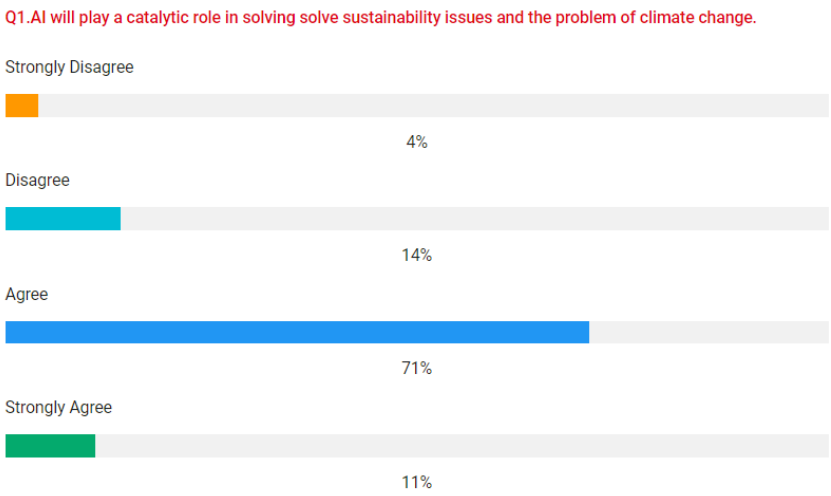
[1] 26th UN Climate Change Conference of the Parties (COP26), held in Glasgow from 31st October – 13th November 2021.

This meeting was chaired by co-Chair **Lord Clement-Jones CBE**.

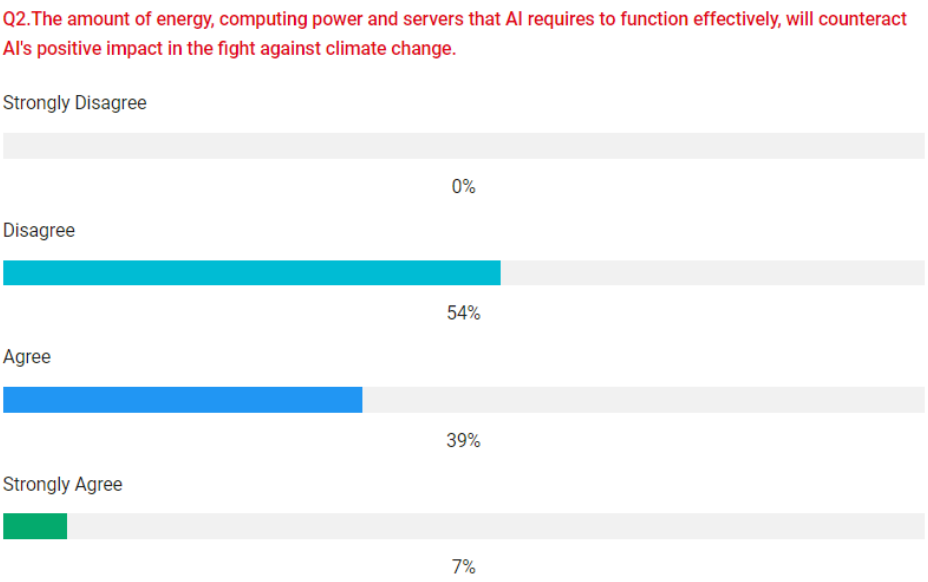
Parliament has appointed Big Innovation Centre as the **Secretariat of the APPG AI**, led by **Professor Birgitte Andersen (CEO)**. The Project Manager and Rapporteur for this meeting is **George Farrer**.

2. APPG AI Pavilion Survey

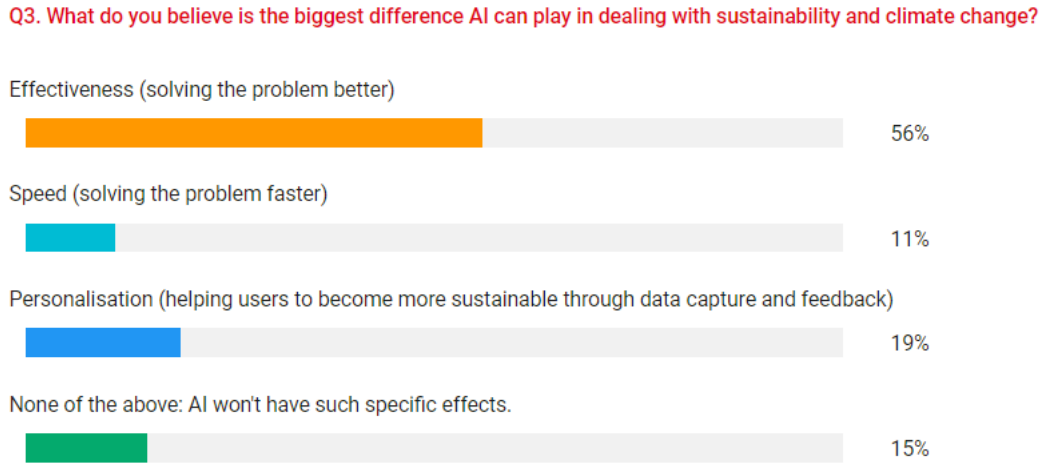
Prior to the APPG AI meeting, a survey was issued on the **APPG AI's Pavilion Platform**.



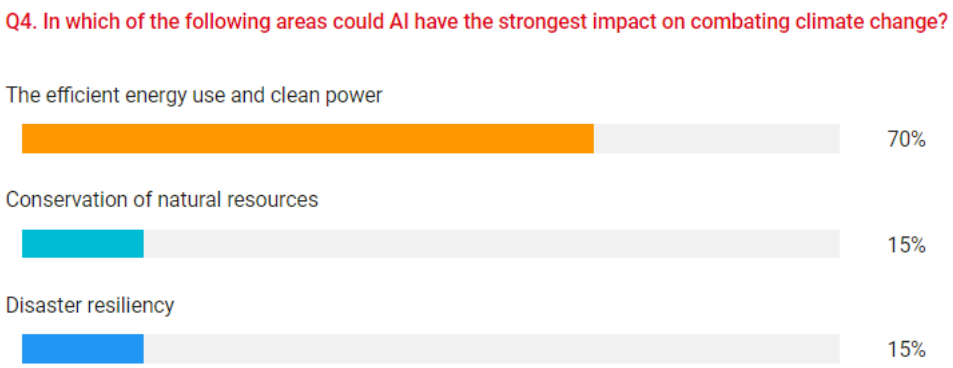
Question 1 examined APPG members on whether they believed that *'AI would play a catalytic role in solving Sustainability issues and the problem of Climate Change'*. **'Agree'** was the overwhelming response given here, showing the power that AI has in tackling Climate Change, and the potential it has to do so at a rapid rate. On the other hand, only 18% of respondents thought the statement was false (either **'strongly disagree'** or **'disagree'**).



Question 2 proposed the statement, *'the amount of energy, computing power and servers that AI requires to function effectively, will counteract AI's positive impact'*. Here, the majority of APPG AI members **disagreed** (54%). However, 39% of those who answered the survey did **'agree'** that the power that AI requires to run effectively would hinder the good that AI can do when it comes to dealing with Climate Change and Sustainability. This question was much closer in terms of answers than question 1, showing the lack of consensus on the issue of AI's initial environmental impact, compared to the impact AI can have in the long-term.

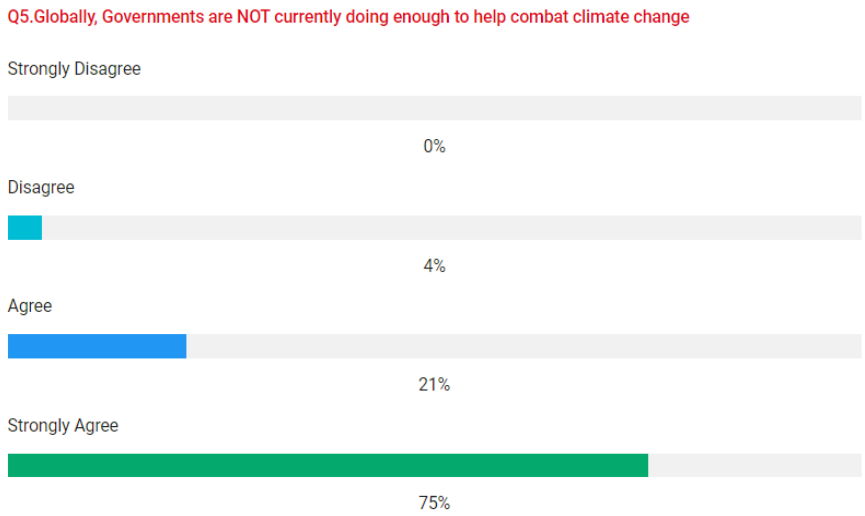


Question 3 considered the ways that AI can help deal with Climate Change and Sustainability, in terms of AI's characteristics. 56% answered that the **'effectiveness'** of AI is the biggest difference (*'solving the problem better'*). This answer was the clear frontrunner, with the other characterics, **'speed'** and **'personalisation'** receiving a combined 30% of the vote. However, despite the advantages of AI in dealing with Climate Change, 15% of APPG AI members did contend that **'AI will not have such specific effects'**.



Question 4 queried which area out of, '*efficient energy use and clean power*', '*conservation of natural resources'* and '*diaster resiliency'*, AI would have the strongest impact on? 70% considered that **'efficient energy use'** would be the area that AI would have the largest effect on. The expert speakers, in their evidence giving agreed that AI has the power to combat rising emissions and help to put the use of clean power to the forefront – this shows a large amount of consensus on this particular issue. **'Conservation of natural resources'** and **'disaster**

resiliency' both received 15% of the vote respectively, displaying that APPG AI members feel they won't be helped as much from the potential of AI as **'efficient energy use and clean power'.**



Question 5, took a broader perspective on the issue of Climate Change, asking APPG AI members whether they belived that '*globally, governments are not currently doing enough to help combat Climate Change*'. The answer here is fundamentally clear. Three quarters of respondents **'strongly agree'** that governments are not doing enough at this stage and need to do more. Another 21% would not go as far, but still **'agree'**. This left just 4% who **'disagree'**, and would say that governments are currently doing enough to combat Climate Change.

3. Recommendations for policymakers

1. **Artificial Intelligence (AI) is an effective tool to deal with Climate Change and Sustainability issues.** The characteristics of AI make it a great technology to help reduce emissions. **AI can work at speed and with a global scale.** Machine learning algorithms can be used in the fight against Climate Change, especially for modelling and creating digital twins. AI is able to transform complex and manual processes into automated analysis to drive concrete action.
2. To get the greatest benefit out of AI, it should be utilised alongside other technologies. **Technologies such as Internet of Things and 5G can complement AI to help tackle Climate Change and Sustainability**. AI is not a silver bullet, it will not solve the problem alone, as it can be subject to biased or bad data. Therefore **AI needs to be balanced with other technologies** and drivers, including policies and financial incentives, to help reduce emissions.
3. **A skills pipeline of those with real domain experience is required,** to go alongside computer scientists and those with PhD's. Skills need to improve, with grater focus and coordination to build this talent pipeline for areas where AI can be applied, like combating Climate Change. **Those who can manipulate energy data and understand environmental models are just as essential as those with PhD's**, this will aid the rapid adoption of AI technology in Government structures.
4. **Sustainable AI is just as important as AI for Sustainability**. The Sustainability of AI has to be an element within AI governance. Computer-intensive technologies have the potential to be counter-productive when trying to enhance Sustainability. We should be somewhat measured when using computer-intensive models, considering how much energy has already gone into training. **AI should have the goal of being net-positive**.
5. AI should be used for accurate measurement. **We cannot reduce carbon emissions if we cannot measure them, therefore measurement is the first step to bringing down emissions**. How can we track change and evaluate the effect of policy changes if we don't know the level of emissions? We need to be better at translating insights and data into action. **Measurement is a key step** in analysing and reducing carbon footprints, for individuals, companies and governments.
6. Using **data from different sources** will help tackle the challenges of AI and Sustainability. There should be an open-source community of data within machine-learning researchers. However, we must **consider how to integrate open-source information with commercially sensitive information** to bridge together digital twins across many sectors.

Our expert speakers at the meeting all agreed that Artificial Intelligence and machine learning do have the ability to help combat Climate Change and tackle Sustainability issues in a number of areas. **AI has the potential to flow into all sectors** such as wind and solar energy, and the task to reduce carbon emissions, along with issues concerning biodiversity and habitat protection. Following the **COP26 Climate Change Conference in 2021** (COP26), the panel believe that AI has a huge capacity to deal with Climate Change, and with backing from Government can exponentially increase the tools at our disposal to mitigate climate disasters and global warming.

There was certainly widespread agreement among the expert speakers that AI should be used to measure carbon emissions. Provocative questions were asked, such as 'how can we start to reduce emissions, if we cannot measure them?' This could definitely be a way to introduce AI more into the realms of Climate Change, to use **machine learning and AI for accurate measurement of carbon emissions**, which are damaging our planet. Once emissions have been measured, we can then use AI for futher impact.

Additionally, there was a concurrence that, despite the power of AI for good in the Climate Change fight, AI would not be a straight-fix all by itself, and **requires other emerging technologies alongside to realise its full benefit**. Technologies such as 5G and internet of things systems coupled with Artificial Intelligence would help AI be at its strongest when tackling Climate Change and Sustainability issues. There was a common consensus between all experts that AI is definitely not a silver bullet, which could solve issues all by itself, as it can be subject to bad and biased data, also sometimes finding correlation, not causation. Therefore, AI would be at its strongest in tandem with other technologies, when fighting Climate Change and looking to enhance Sustainability.

Dr. Anand Rao, Global Artificial Intelligence Lead at PWC, starts by detailing two seminal reports by PWC, which look at the impact AI can have on Climate Change, focusing on where AI can be used. Rao, reports specific use cases around where AI can help work towards the sustainable development goals. Furthermore, Rao states that within PWC's report with Microsoft, **'AI and a Sustainable Future'**[2] they analysed the economic quanitification and value generated through some of the use cases where AI is being used to help tackle Climate Change.

Rao then focuses his presentation upon efficient energy use and the reduction in coal power. He details how in the United States, coal power accounts for one quarter of all energy-related carbon emissions, therefore needs substantial reductions. Rao explains how **machine learning algorithms can help forecast the supply of low carbon power technologies**, such as wind and solar – which are less harmful for the environment than the production of greenhouse gases. Predicting supply and demand allows you to have cheaper and cleaner fuels to power the base load and react to unforeseen events, which require a spike in demand.

---

[2] PWC – **'How can AI enable a sustainable future'**. https://www.pwc.co.uk/sustainability-climate-change/assets/pdf/how-ai-can-enable-a-sustainable-future.pdf

Rao details how layout optimisation of wind and solar power through deep learning and neural networks can result in more efficient energy use.

Rao finishes his presentation on the issue of carbon calculators, stating that **dynamic carbon calculators should be preferred over the current, static calculators**. This would allow all individuals to see their real-time impact on carbon emissions, through their car and home, along with other activities. This would then allow us to compete to change our behaviour, affecting businesses, inviduals and the broader ecosystem.

Dr. Aidan O'Sullivan, Associate Professor in Energy and Artificial Intelligence at the UCL Energy Institute, and Co-Founder at Carbon Re, starts by stating that we need **gigatonnes of impact** when it comes to reducing emissions in order to return to a 1.5°C world. O'Sullivan details how the **characteristics of AI make it a great technology to help achieve this goal**. He describes that AI can work at speed, helping us to reduce emissions now, and at scale, with impact all around the globe concurrently. Additionally, O'Sullivan mentions that AI has the characteristic of constant attention, meaning that it never gets tired or bored, and is able to perform the same tasks over and over again, especially when dealing with very complex and closed systems. AI is able to be upgraded immediately, unlike other software, so is a very strong technology when considering the operation of infrastructure in order to maximise efficiency when trying to combat Climate Change.

Moreover, O'Sullivan goes on to discuss **Carbon Re**[3], the university spin-out of which he is the Co-Founder. Carbon Re was formed with the goal of having gigatonnes of impact, what O'Sullivan contends is needed to reduce emissions. Carbon Re is working with the cement, steel and glass sectors, which contributed to 20% of global emissions, and require lots of fossil fuels to heat kilns in order to go about their work. One of Carbon Re's projects is **Delta Zero**[4], a recommendation engine which is using AI to reduce carbon emissions from a concentrated source, based on the variable inputs that they may be receiving. O'Sullivan describes how, through working with a cement plant in India, Carbon Re have managed to reduce the plant's emissions by 9% in 4 months. Therefore, there is definitely room for AI to help in the fight against Climate Change, at the industry level.

Diana Dimitrova, Managing Director at Boston Consulting Group (BCG), initiates her presentation by telling the APPG AI of a **BCG study**[5] where they found that 90% of companies consulted (total of 1290 companies), do not measure their emissions comprehensively. Furthermore, the study also found that less than 1% of these companies have meaningfully reduce emissions in the past 5 years. Moreover, Dimitrova contends that **you cannot reduce emissions, when you cannot measure them**. She believes that an accurate, standardised and automated way of measuring emissions is needed in order to take the right decisions in this space. Out of the technology that is available to us today, Dimitrova states that AI is the

[3] **Carbon Re**. https://www.carbonre.tech/
[4] **Delta Zero** – A Carbon Re Project. https://www.carbonre.tech/delta-zero
[5] Boston Consulting Group – **'Use AI to Measure Emissions: Exhaustively, Accurately, and Frequently'**. https://www.bcg.com/publications/2021/measuring-emissions-accurately

most powerful element in the fight against Climate Change, due to its ability to turn complex and manual processes into concrete action.

Additionally, Dimitrova cites BCG's software solution, **'CO2 AI'**[6]. CO2 AI has the power to quantify emissions and set appropriate reduction actions. Dimitrova tells the group that BCG have been working with a UK Government Ministry who are looking to become net-zero by 2040, however this target was ambitious because of the Ministry's low data granularity despite making large capital expenditure decisions which would drive emissions for years to come. BCG used AI to work with the Ministry to formulate a granular, actionable path to their net-zero by 2040 target. They found that a lot of emissions were being caused by non-critical activities, such as moving cargo, which was not one of the primary activities of this Ministry. This allowed for flexibility to use AI and simulate pathways to net-zero, considering alternative abatement paths, and formulating that using hydrogen and alternative transport modes would be one of the best options in the short term.

Therefore, this demonstrates that **with the right methodology and AI, emissions figures can be estimated much more accurately**, covering all aspects of a company, from top to bottom, that may drive emissions up or down. AI can help find the most impactful abatement levers and run trade off analysis of decisions. Dimitrova states that we need to utilise software and AI as soon as possible to help tackle Climate Change; AI will not solve issues on its own, but will have a dramatic impact on what we can achieve.

Pete Clutton-Brock, Co-Founder at the Centre for AI and Climate, states that there were increased commitments in terms of tackling Climate Change in the run-up to the COP26 Climate Change Conference in November 2021. However, this resulted in little action and we are yet to see meaningful commitments from large carbon emitting countries in terms of a reduction in the use of fossil fuels. Clutton-Brock, exhibits the Global Partnership on Artificial Intelligence's (GPAI) report, that was released at COP26, titled '**Climate Change & AI: Recommendations for Government Action**[7], of which he was a co-author. This report details the opportunities where we can apply AI to different sectors associated with Climate Change, such as energy, transport, disaster response and agriculture. AI flows into all sectors that we care about when it comes to Climate Change, in order to translate insights and data into meaningful action.

Clutton-Brock describes some of the opportunities of implementing AI into Climate Change action. He believes that **AI has the potential to distil data into useful insight**, transforming raw data into information that can be used in the fight against Climate Change and Sustainability issues. For example, machine learning (ML) has been used to automatically label high resolution satellite images to identify emissions point sources and quantify them. Additionally, Clutton-Brock details how **AI can help with forecasting**. He states that AI can

[6] **CO2 AI** – Boston Consulting Group's software solution. https://www.bcg.com/beyond-consulting/bcg-gamma/co2-ai-for-sustainability
[7] Global Partnership on AI – **'Climate Change & AI: Recommendations for Government Action'.** https://www.gpai.ai/projects/climate-change-and-ai.pdf

absorb historical data to make accurate forecasts for the future; this has been seen in terms of solar and wind power and optimising forecasts for agricultural yields. In the future, we are going to need more renewable energy in our grids, therefore this requires a more accurate forecast of renwable power and demand.

However, despite the opportunities AI and machine learning can provide when it comes to mitigating Climate Change, Clutton-Brock explains that there are some challenges to AI's utilisation. **Challenges include data collection, access, quality and standards**, which all need radical improvements, along with research and skills which require more coordination and a greater focus on a skills pipeline. In addition, there are challenges when it comes to funding. Clutton-Brock argues that venture capitalists may understand the potential value, but they are more wary of the AI for climate sector than others, with less funding here than in FinTech, healthcare, the automoative industry and AdTech for example.

Prof. Gavin Shaddick, Co-Director of the Joint Centre for Excellence in Environmental Intelligence (JCEEI), agrees that AI can help tackle the issues of Climate Change and Sustainability, but reaffirms the consensus view of the panel that we cannot reduce carbon emissions, if we cannot measure them. Prof. Shaddick details that around $^{2}/_{3}$ of the 93 environmentally-related Sustainable Development Goal (SDG) indicators [8] do not have any data to measure them, so there is no way to track progress towards the SDGs. Therefore, there is a big data inequality here, especially between the global north, along with India and China, compared to the rest of global south where there is a lack of information available that we need to understand the environment.

Prof. Shaddick, contends that **AI is being used to integrate data from multiple, very contrasting sources**, in order to bridge spatial scales – for example, satellite imagery with ground sensors. Food security, is an area where this is increasingly being used. **The Joint Centre for Excellence in Environmental Intelligence**[9], is integrating climate projections with crop and disease models to understand how the climate will change over the coming decades and affect agriculture in the UK, especially the potential for new pests and diseases to have a negative impact. The JCEEI have created a **Climate Impacts Mitigation Adaptation and Resilience Framework (CLIMAR)**[10], which brings together these multiple sources using data science and AI.

Moreover, Prof. Shaddick states that he wishes for organisations, governments, businesses and academia to work together in the fight against Climate Change. He states that the **CReDO 'Climate Resilience Demonstrator'**[11], developed prior to COP26, which had the aim of building a digital twin across energy water and telecommunications networks. This would look at climate projections and hydrological models and see the effect this would have on flooding

[8] **UN Sustainable Development Goal Indicators**. https://unstats.un.org/sdgs
[9] **Joint Centre for Excellence in Environmental Intelligence**. https://jceei.org/
[10] **CLIMAR Framework** - climate impacts, mitigation, adaption and resilience framework, produced by the JCEEI. https://jceei.org/projects/climar/
[11] **CReDO** – A climate resilience demonstrator created by the Digital Twin Hub. https://digitaltwinhub.co.uk/credo/

in the future. Not only the effect on flooding but the further knock-on effects. Prof. Shaddick dictates that the real benefits in building digital twins and using AI and data from different sources is being able to **bring together different models** to see how things might affect when looking at more than one output at a time.

4. Evidence statements

Dr. Anand Rao, Global Artificial Intelligence Lead, PWC

Most of the work that I am talking about today is an extension of two seminal reports that we at PwC have done.

In 2018, we worked very closely with the World Economic Forum to publish a report on **'Harnessing AI for Earth'**[12] and the **'Fourth Industrial Revolution for the Earth'**[13]. There are six areas that we identified and we found specific use cases within those six areas. All of those areas are very much what the Sustainable Development Goals (SDGs) focus on:

- Climate Change.
- Biodiversity.
- Healthy oceans.
- Water security.
- Clean air.
- Weather and disaster resilience.

These are very much like the 17 SDGs that we have. There are several areas where we

[12] PWC & The World Economic Forum – **'Harnessing Artificial Intelligence for the Earth'**. https://www3.weforum.org/docs/Harnessing_Artificial_Intelligence_for_the_Earth_report_2018.pdf
[13] PWC – **'Fourth Industrial Revolution for the Earth'**. https://www.pwc.com/gx/en/sustainability/assets/ai-for-the-earth-jan-2018.pdf

highlighted where AI could be used, as well as where AI is being used. Moving on four years to now, there have been number of those use cases where people have implemented many of these.

Subsequent to the 2018 report, we partnered with Microsoft to produce a report around **'AI and a Sustainable Future'** (2019) where we took some of the use cases but went deeper into the economic quantification of that and the value generated by doing some of those actions. Obviously, we looked at the carbon footprint as well as the economic value of that, together with Microsoft. Gross Domestic Product (GDP) growth can be facilitated by taking some of these actions, with AI being the focal point. However, there are a number of other related technologies that you really can't separate – things like internet of things (IoT) sensors, 5G and along with others that go hand in hand to generate that GDP value as well as the reduction in the carbon footprint.

Efficient Energy Use & AI

The COP26 targets in terms of efficient energy use focus upon clean energy, sustainable cities and then responsible consumption and production as the key areas to target. One of the key areas that was targeted under COP26 was to reduce the usage of coal power. In the United States, coal accounts for roughly one quarter of all energy related carbon emissions, therefore in at COP26 in 2021 in Glasgow, the US set about to reduce greenhouse gas emissions by 50-52% before 2030.

A number of machine learning algorithms are being used to improve the scheduling and improve the forecast of supply of low carbon power. Allowing the demand and supply to be better predicted means that you can have cheaper or cleaner fuels to power the base load. IoT devices can understand the issues of forecasted demand, as well as unforeseen events which usually results in a spike in costs and a spike in energy usage of the wrong kind.

How can we use AI from a policy perspective? We have built various climate models and carbon decarbonisation models which utilise 'what if' analysis, and 'what if' scenarios. By finding alternative scenarios for companies and for different groups, associations and countries can look at their carbon footprint. Then, they can see what actions can be taken and the trade-off of those actions on other issues regarding equity, regarding health or the effect it has on the broader community, not just economic but also the socio-economic impact. Companies such as Microsoft and Google are using some of their in-house AI to make a big dent into their energy consumption. Google is optimising a **DeepMind**[14] AI algorithm, launched in 2016 to autonomously run its data centres' cooling systems. There is a lot of action happening.

I just wanted to give a couple of examples here. Wind and solar are the two alternative sources and you can see AI being used in a number of areas, layout optimization of wind turbines

[14] **Deepmind** – Artificial intelligence subsidiary of Alphabet.Inc. https://www.deepmind.com/

being a major one – this is a very active area of research. There are a whole host of things where people are using neural networks and deep learning to make a dent around optimizing and having better layout optimization with the wind. This doesn't just stop with wind; it goes into solar energy sources and a number of other areas, such as nuclear - you always see this use of AI in optimization. An example is Deep Mind, and how they have used the their AI to control the cooling bill within their data centres. They are obviously one of the bigger data centre consumers of energy.

Conservation of Natural Resources & AI

In terms of natural resources, as humanity we are having an impact on poaching for example, and the various species that that are diminishing in terms of biodiversity. Therefore, we need to see how we can use AI in some of these areas. For example, in Cambodia…

- **Challenge**: 20 years ago, Cambodia had a robust tiger population. In 2019, the country had no tigers
- **Target:** WWF is supporting the Royal Government of Cambodia's tiger reintroduction plans
- **Action:** With PAWS (Protection Assistant for Wildlife Security – a predictive AI software) 24 rangers patrolled areas and recovered just under 1,000 snares (thin wire noose) in 24 days at Srepok Wildlife sanctuary

There are a range of things in terms of machine learning algorithms, building sustainable supply chains and using blockchain coupled with AI. Machine learning algorithms have been implemented for habitat protection and restoration, along with pollution control to protect habitat species. Additionally, AI is used to help reduce deforestation and identify sites for afforestation by using remote sensing imagery and computer vision.

Here is an example which is more around using images and image analysis. This is something that's happening in Gabon, which has 24 billion hectares of forest. In one of the largest highly forested areas there are 400 species of mammals and 1000 fishes and birds. AI is helping them to detect those species. There are small cameras, which are motion sensing, so they can not only see the motion, but they can detect the species, they can track movement of both animals and humans, in order to identify guns and poachers and therefore alert in real time to others. This is a strong example of where we are using some of the deep learning from the vision systems, camera tracking and all the devices that come with it, to do something very useful in terms of controlling the project.

Disaster Resilience & AI

Around disaster resilience, AI has had several areas of impact from the COP26 perspective. The number of climate related disasters has been increasing over the past couple of decades, it's been accelerating. Aerial imagery, using computer vision, using natural language processing techniques, using simulation modelling to do 'what if' scenarios for disaster

resilience, have all been happening, in order to meet **UN target 13.1**[15].

Reducing coal use by 50% can help reduce emissions by 12.5% in the US, therefore helping to combat Climate Change. Being in the pandemic era for the past couple of years, has accelerated some of the ways in which these models that develop the data have been used. The collaboration between academics, businesses, government, and policy makers has been happening very much in a crisis mode over the past two years. I think we can take some of those examples and push forward in the next era of looking at Sustainability and having the same urgency towards this. Machine learning algorithms have been used for disaster modelling, preparedness, response and recovery. Additionally, deep learning is applied for storm tracking and finding drought intensity using images.

We ourselves, at PwC have been working on supply chain risk. We have developed several AI algorithms being used by a number of people. The article, '**Applications of artificial intelligence for disaster management**[16]**'** demonstrates how to mitigate, get prepared, and respond and recover from natural disasters.

During the COVID period, this is something that everyone has been doing, essentially as the coming together of models, which are both geographic and temporal given the speed at which the virus was moving. It's also happening at multiple layers between individuals, households, society, school, communal areas and countries, and so on. This is not only just the tracking of the disease, but the behavioural issues and how government policies impact the way we behave, and how that impacts the economy in terms of our usage. All of this have been modelled in various ways, looking at economic but then going into very specific sectors.

We really need to move more into the action frame here. We need to try to bring in the data, the models, make the computation available and have it with an appropriate and responsible governance, so that the data is being used for the right issues. We need to be building models, one on top of the other to make it much more of an open world. Especially within Climate Change and Sustainability, there's an opportunity to do this because we are all impacted a member of the world by Climate Change.

I want to just leave with one example. The way, I think the action will happen is at a level where individuals, businesses and governments all come together. When we look at the carbon calculators of today (e.g., UN Carbon Footprint Calculator & **CoolClimate Network**[17]) most of them are very static calculations. What we really need is to move beyond the static to a much more dynamic calculation. We should provide something for all individuals to tangibly see their impact and then, just as we compete for likes on Facebook or social media, we should be competing on how much we are changing our behaviour in order to address some of the

---

[15] **United Nations Target 13.1** – Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
https://unstats.un.org/sdgs/metadata/?Text=&Goal=13&Target=13.1

[16] **'Applications of Artificial Intelligence for Disaster Management'** (July 2020) (Available at: https://link.springer.com/article/10.1007/s11069-020-04124-3)

[17] **Cool Climate Network Carbon Calculator**. https://coolclimate.berkeley.edu/calculator

carbon footprints. Everyone should have a carbon footprint, which is dynamically calculated based on every action that we do and then make suggestions on how we can bring it down. This flows into the businesses, and subsequently the broader ecosystem.

Dr. Aidan O'Sullivan, Associate Professor in Energy & Artificial Intelligence, UCL Energy Institute / Co-Founder, Carbon Re

As the Climate Change discussion has evolved, climate science has perhaps become less important, there is less disagreement, but again, the scale of the challenge has become important.

To give context to what we need to achieve, the IPCC (Intergovernmental Panel on Climate Change) scenarios project that we're on a path towards 59 gigatonnes (GTs[18]) of CO_2 on our current trajectory, and that would lead us to a 3.5°C world, when we want to be as the 1.5°C world, which is an order of magnitude in terms of emissions reduction. We need to see 34 GTs of CO_2 reduced to bring us down into that level of only emitting 25 GTs of CO_2 in order to stay within that 1.5°C world. For comparison the impact of COVID, which was hugely disruptive and hugely transformative, only reduced emissions by 2.3 GTs. Despite everyone staying at home and no one traveling, these huge social transformations and got us nowhere near the level of change. When we're talking about action on Climate Change, we need to talk about gigatons of impact.

Characteristics of AI

This is where AI comes into play. The technology solutions that we need to achieve these reductions need to have two key characteristics: speed and scale.

[18] A gigatonne (GT) is 1 billion tonnes, and is often used when discussing human carbon dioxide emissions (Energy Education, June 2018 https://energyeducation.ca/encyclopedia/Gigatonne)

- Emissions have a cumulative effect, we need to be reducing emissions now. A tonne of CO_2 reduced today, is as important as to two tonnes of CO_2 reduced in 10 years.
- We also need solutions that scale globally in order to have this gigatons impact. We can't have local solutions, we need to be able to deploy technologies that can scale globally in a different way to say how hardware scales.

AI by virtue of being a software technology embodies these two characteristics naturally.

When talking about how AI can impact Climate Change, I think it's nice to have a general framework for thinking about where you can deploy AI. Obviously, AI is not a silver bullet, it's not something that you can deploy anywhere and everywhere but it has characteristics that help you think about where it can be used as a solution to problems and start to reduce emissions and have a serious impact.

AI has this characteristic of constant attention – AI never gets tired or bored. Also, AI has very quick decision making speed, so when trained decisions occur that are far greater than humans. AI is ideally suited to very complex but closed systems; humans deal very well with open systems where new actors can emerge and the state of play can change very regularly. On the other hand, we see a lot of AI developed for board games or for video games, where it's very closed world where the pieces are defined, and everything is nice and easy, rather than open systems. Again, if we're thinking about how we deploy AI to reduce emissions at the gigaton scale we need to think about the operation of infrastructure to maximize efficiency.

I work at the **UCL Energy Institute**[19], the largest research institute for research into energy transformation and energy transition in UK. While we've seen renewables at the forefront of Sustainability in energy transition, one thing that's been measured is the rate of adoption or the rate at which the cost of these technologies falls per rate of installation. We've made great progress, particularly on solar but there are hardware curves and technology learning rates that have to evolve, at a certain speed, and learning rates of 30% means the cost will fall by 30% over 10 years. If you compare that to the scale of the challenges that we have, it's quite clear that it's not an appropriate solution, or the whole solution for the problem that we have.

By contrast, if you look at AI as a software technology, it is completely different to hardware. You can upgrade immediately, you don't have to wait for the lifetime of your asset to be fulfilled before you make an investment again, you can keep iterating and keep improving. This is a technology that helps us in the speed of action that we need to take.

AI for Gigatonnes of Impact

To move on to scale, where can AI be deployed for gigatons of impact? This is really the critical issue. The target is applications where marginal operational improvements yield big emissions savings. We want low complexity, high impact, easily repeatable solutions, in terms of the data

[19] **UCL Energy Institute** - https://www.ucl.ac.uk/bartlett/energy/

processing and in terms of the data engineering, you don't want to have to rebuild the system, every time. We should be targeting sectors where there are concentrated sources emissions, so don't rely on an individual 'patch'. You want repeatability, you want closed systems and, of course efficiency is the best fuel. Where could the characteristics of AI enable better infrastructure management? This is something government needs to value a bit more. The idea of megawatts or efficiency isn't as appreciated as building a new wind farm, for example. Why we need those as well, there needs to be a bigger emphasis on doing things more efficiently.

Carbon Re

This is where **Carbon Re** comes in. Carbon Re is a university spin out that I've developed. We were founded based on the process of thought that I just described, to have gigatons of impact. That led us very naturally into the energy intensive manufacturing sector. The manufacturing of cement, steel, and glass are responsible for 20% of global emissions. We're applying AI to reduce emissions from these industries, being a central focal point for technologies. We've been successful so far, we've raised £1M of seed funding from the University of Cambridge's clean growth fund and UCL Tech Fund. We currently have a team of about 10 people.

There are a lot of emissions released from cement production. In order to achieve the temperature needed for the manufacturer's material, you need really high temperatures, 1200°C in the kiln- that requires fossil fuels. There's only 3,000 cement plants in the world, but they account for around 8% of total global emissions. If you put that into comparison, the emissions, for a typical cement plant for one year is equivalent to 250,000 cars. Just 10 cement plants are equivalent to all the cars in London. What we're doing is looking to deploy AI to reduce emissions from this major concentrated source of emissions.

We've been deploying a pilot project in India, giving them live access to our technology which is called **Delta Zero**. This consists of a recommendation engine which we use to help operators run their plant more efficiently, to help them achieve the kind of the best class performance for that day, based on the kind of the variable inputs that they might be receiving. In these environments because they're very low margin industries, their fuel supply will change very regularly. Particularly with the current fuel crisis people are looking to change their fuel sources depending on price and respond very strongly to that. What we do is we send recommendations, based on that, based on the quality of inputs, and work out how they can maximize the throughput of their process while maintaining the quality of the output. This lets us reduce the fuel consumption and change the way the process operates more efficiently. Over the last four months we've been responsible for a 9% reduction in energy consumption at a cement plant in India. This is obviously very significant in terms of emissions, this is a plant that burns tonnes and tonnes of coal every day we're hoping to reduce that by 10%.

In terms of next steps, we're targeting one megaton of reductions within the next year. We're currently at about five kilotons so we're scaling out and seeing what we can do. We're looking to give the best AI talent in the industry, an opportunity to deploy their talents in work that has

a positive impact. A counterpoint to say working with targeted ads and such, is to use your AI technology and AI skills to help reduce emissions and help us with our technology. What we want to do is engage with these industries that have been really impacted by the fuel crisis and give them access to technology that they don’t have a capability for themselves. Just by the nature of the way AI has developed and machine learning expertise is concentrated we're seeing ourselves as a central hub for artificial intelligence, material science and manufacturing.

Diana Dimitrova, Managing Director, Boston Consulting Group

I will be speaking on the topic of how AI can support the Sustainability journeys of both public and private sector, and specifically I will focus on measurement and management of emissions.

We all know that we need to act, and we need to act fast to combat Climate Change. We only have 8 years left to cut emissions by half to reach the goals set in the **2015 Paris Climate Change Accords**[20]. Standard setting is increasingly being addressed, we expect more to come from regulatory bodies, but we can all look to the **U.S. Securities and Exchange Commission (SEC)**[21] when they recently announced intentions that all US listed companies will disclose their greenhouse gas emissions, including scope three[22] material. This is a fundamental step forward and will require companies to move very quickly.

We at Boston Consulting Group (BCG) conducted an extensive **study** about two years ago, where we surveyed 1290 companies and their decarbonisation journeys and the results we found were quite alarming. The outcome showed that 90% of companies don't measure their emissions comprehensively across the three emission scopes. Less than 1% of these companies have meaningfully reduced emissions in the past five years. This really

---

[20] The Paris Climate Accord, signed in 2015, is legally binding international treaty on Climate Change. It was adopted by 196 parties at COP21 in Paris.
[21] **'SEC Proposes Rules to Enhance and Standardize Climate-Related Disclosures for Investors'** – US Securities & Exchange Commision. https://www.sec.gov/news/press-release/2022-46
[22] **Scope 1** emissions covers direct emissions from owned or controlled sources. **Scope 2** covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company. **Scope 3** includes all other indirect emissions that occur in a company's value chain.

demonstrates the core problem that I'm choosing to hone in today; the problem that you can't reduce what you don't measure.

It's a bit like when you go shopping and you want to save some money but there's no price tags on anything, so how do you know what to buy or how much you spend. This is the exact challenge that many large corporates face today when it comes to net zero, this is the starting point. We really need an accurate, standardized, and automated way of measuring emissions to take the right decisions. Many of you will know this is not easy. Reducing emissions across scope one, two and three, by any large organization, either public or private is no trivial task. There's thousands of activities that emit greenhouse gases and all of them need to be estimated in a decently accurate way.

The good news is that we have technologies and tools available to support the comprehensive measurement of carbon emissions for organizations. These tools, in addition to being able to measure, have decision support in them, as well as visualization of the journey which enables executive decision – then you can set targets or look at your gap to target. One of the most powerful elements built into the technology is artificial intelligence. It's essential in the fight against Climate Change, because of its ability to accelerate complex, very manual processes, automated analysis and it can drive accurate and concrete action.

CO2 AI

At BCG we have developed a software solution called **CO2 AI** which enables organizations to reliably quantify their emissions, make well informed decisions and set appropriate reduction actions.

We recently piloted CO2 AI in a UK ministry with some fascinating findings. The particular ministry is quite a leader in their space in terms of how they think about their emissions, but how quickly they want to get there. The ministry had communicated ambitious targets to become net zero by 2040, so as most of us know about 10 years ahead of the rest of the curve. The target was even more ambitious, given that they had low data granularity and quite decentralized data sources. That data granularity was especially important, as they were making large capital expenditure decisions now, these commitments, would drive emissions for the decades to come. Evaluating these decisions, using AI enabled estimation methods gave the ministry a granular, actionable path to their net-zero 2040 target.

We supported the emissions baseline modelling across all three scopes and while we did that, we had some fascinating discoveries. We discovered the most of their emissions were concentrated in non-critical activities, such as moving cargo. Since this was not the primary activity of the ministry, this opened up a lot of doors for flexibility. We used AI and we simulated different pathways to net zero and uncovered that their current plan was very costly. We had to find alternate investments, we needed to evaluate alternative abatement paths. While our clients initial thinking relied on green energy and sustainable aviation fields, we developed scenarios that considered the potential of hydrogen or alternate transport modes, in the short term, and therefore it really opened up the space of what they could do to reduce their

emissions.

What this example really shows us is that, with the right methodology and the power of AI, emission figures can be estimated much more accurately. In fact, our research shows correction potential of about 30 to 50%, compared to manual and traditional methods. Furthermore, AI and advanced analytics can support the process of identifying the most impactful abatement leavers and running analysis on the trade-off between decisions. This allows organizations to have meaningful targets, move to action and actually track that progress, so focused on that latter part of the activity set.

I just want to highlight again the importance that we place an accurate measurement of greenhouse gases. Measurement needs to cover all activities of an organization across all sources that drive emissions up or down. We need to apply the same rigour to carbon measurement as we have to financial accounting. Looking at the hotspots and taking action I think most of us would know that it took about 100 years to put modern, automated, financial accounting in place, but the urgency of Climate Change doesn't give us that luxury for having another century. We need to look to software and AI to act fast and get the required standards, policies and supporting systems in place as soon as possible. This will reduce uncertainty enormously across public and private players and drive action to measurement analysis and ultimately reduction. I'm a firm believer that AI won't alone solve the problem, but I think it can get us a extremely far to enable us to move much faster.

Pete Clutton-Brock, Co-Founder, Centre for AI & Climate

I thought I'd maybe locate us in the COP26 agenda process, to set the framework here. The key aim for COP26 was really to keep alive the 1.5°C targets. In other words, the chance of maintaining the global average temperature rise to no more than 1.5°C. We saw a lot of progress on that, in the run up to and during COP26 in terms of increased commitments both from countries and companies, to reduce emissions. However, the sum of those commitments ended up being insufficient to meet the target, this became apparent at COP26. As a result, countries agreed to revisit and strengthen their climate targets this year in time for COP27 in November 2022, in Egypt.

However, this year we're yet to see meaningful increases in commitments from large emitting countries and many not on track to meet their existing commitments. However, clearly the geopolitics have changed recently since COP26 with Russia's invasion of Ukraine. Many countries are now looking speed up the decarbonisations to reduce their reliance on fossil fuels, as a result. How that translates in specific commitments for COP27 remains to be seen.

In regard to AI specifically and COP26 also saw the launch of report entitled, **'Climate Change and AI: Recommendations for Government Action'** of which I was one of the authors. This report offers an analysis of the opportunities for applying AI to Climate Change, the challenges of doing so and offered recommendations for governments around the world on how they could support this space.

The report details areas of opportunity for applying AI to climate challenges and I think these span all the sectors that we care about when it comes to Climate Change, including energy, transport industry, buildings, forests, agriculture, adaptation and disaster response. The report was developed for the Global Partnership on AI (GPAI), which has got 24 member countries

plus the EU and looks to increase interest in the application of AI to Climate Change. This particular project was looking to try and help policymakers understand the opportunities, challenges and the bottlenecks, that are holding back applications and propose a bit of a blueprint for what governments can do to really accelerate action in this space.

Ultimately what we see the potential of AI as being is that it will flow into all the sectors that we care about when it comes to Climate Change. The energy sector, industry sector, also all the other heavy industry sectors that make up a considerable portion of global emissions. Buildings, transport, whether it's public transport or road transport, logistics around the world, but also forests and agriculture, optimizing systems and identifying areas at risk. Adaptation, we need to be much better about translating insights and data into action when it comes to adapting to unavoidable Climate Change. Then obviously climate science, we need to get a much more detailed and granular understanding of where and when we will see the impact of Climate Change come about.

Distilling Observed Data into Useful Insight

In terms of trying to dig into these specifics and describe exactly what the opportunities are, what I'm going to try and do instead is trying to highlight some common use case types that we see a lot. One is, for example, the application of AI to distil observed data into useful insight. So this is where we're taking raw data in some form, this could be time series data for the energy sector or it could be satellite imagery, but it's taking that raw data and steering it into useful and usable information. Whether it's using machine learning to, automatically label satellite images or large bodies of text, this has really valuable use in deployment context. Additionally, whether it's for tracking greenhouse gas emissions using high resolution satellite imagery. Gathering infrastructure data on buildings, pinpointing deforestation, for satellite data evaluating coastal flooding risk, passing company reports, relevant information, all of these are areas where there is potential to really distil insight from observed data.

One example I might draw attention to is a project called **Climate TRACE**[23], where they are using really high-resolution satellite imagery and AI to radically improve the accuracy and transparency of global emissions inventories by both identifying emissions point sources and quantifying them using AI and satellite imagery.

Optimising Systems Control

We also see a lot of use cases around optimizing systems control. When you've got complex systems where the number of permutations for how you change and optimize the control systems is very large, it is impossible for humans to optimize these efficiently. So, these are use cases where AI can make a really big dent and create very rapid reductions in emissions. Whether it's applying it to cement manufacturing to optimise processes or whether it's using it to optimise heating and cooling systems, supply chains or demand response for electricity

[23] **Climate TRACE**. https://www.climatetrace.org/

works, there are a whole range of examples, but optimizing system controls.

One example is **Arup's**[24] smart building optimization tools which can save about 10-30% of the energy use used in a typical commercial building.

Forecasting

Another example is around forecasting. One of the things you see a lot of is using AI to absorb historical data and on the basis of that data make an accurate forecasts or much more accurate forecast than we've been able to do so far. This is important, in a range of contexts, when it comes to Climate Change. We see it in the context of optimizing forecast for solar and wind power. We says in terms of optimizing forecast for agricultural yields, given the data we have, famines and the impacts of Climate Change on them. We see it in the ability to predict prices for carbon markets. All these predictions allow us to basically do things that we weren't able to do before. For example, in the future we're going to need to have vastly more renewable energy in our grids, which will require vastly more accurate forecasts for both renewable power, such as solar that comes down to the grid, but also for the demand, so that we can couple the two perfectly, which we need to do the electricity grid.

Accelerating Simulations

There's a need for really fast physical models and machine learning helps by approximating the output of time intensive simulations. Often what we find is that you have historical, very large and cumbersome models in various sectors that needs simulation. AI can really help increase the efficiency and optimization of those models. You can downscale climate models, we can help make aerodynamic vehicles more quickly by modelling faster, we can speed up electricity scheduling. One case study is a project called **InFraReD**[25] which improves urban design by modelling urban microclimates in seconds, rather than hours.

Accelerated Experimentation

Another one which is somewhat similar, is accelerated experimentation. The speed of digital optimization is much faster than hardware, but what it can also do is optimize the speed of hardware development as well. We can not only model that hardware with digital representation, but we can then optimize the future designs of those hardware models. We can use it for developing better background materials for batteries and solar efficient synthesis methods for fertilizer, which is very energy intensive. One example is a company called **Aionics**[26], software which provides a 10x speed-up in the process for designing better batteries. AI is redesigning hardware systems from the ground-up.

---

[24] **Arup Smart Buildings**. https://www.arup.com/expertise/services/buildings/smart-buildings
[25] **InFraReD** – AI based 'Intelligent Framework for Resilient Design from the Austrian Institute of Technology. https://cities.ait.ac.at/site/index.php/2021/07/24/infrared/
[26] **Aionics**. https://aionics.io/

Challenges

However, all of these use cases are really exciting and then there's huge potential, but there are a series of challenges and applying AI to climate challenges, which would make it perhaps a little bit harder than it should be.

- **Data:** Data collection, discovery, access, quality and standards all need radical improvements.
- **Market Design & Policy**: Policy frameworks and market structures designed in an analogue era have yet to be adapted for digital, yet alone AI.
- **Funding:** Venture capitalists understand the potential value but are more wary of the sector than others. There is significantly less funding in AI for climate, than FinTech, healthcare AdTech and the automotive industry.
- **Research & Skills:** Fundamental research from academic institutions is nascent and patchy. More coordination is needed. A greater focus is needed to build the talent pipeline for specific areas where AI-for-climate can be applied.
- **Start-up System Integration:** Mechanisms that support start-ups to integrate easily into existing incumbent systems are often limited.
- **Knowledge Silos**: It is hard for AI experts to get involved, partly as existing structures are labyrinthine, and as expertise overlaps between the AI community and energy/climate are very limited.

AI is not a silver bullet. There are instances where its use is not appropriate. AI can be sensitive to bad or biased data and can often find correlation not causation. AI can often struggle to explain why an answer is true. We're at the point on Climate Change, where we need to be using every tool than our toolkit for addressing Climate Change and AI is one potentially powerful tool that we can use.

Prof. Gavin Shaddick, Co-Director, Joint Centre for Excellence in Environmental Intelligence / University of Exeter

Environmental intelligence is a bridging of environmental data, science, expertise with artificial intelligence, digital technologies, and others. I'm the lead on environmental Sustainability at the Alan Turing Institute, the UK National Centre for data science and AI.

One thing we do know is that there's been an explosion in the quantity of environmental data, whether that be from remote sensing satellites, from low-cost sensors or numerical models that simulate environmental processes. With this there's been a rapid development in the tools we have at our disposal, whether they be AI, deep learning, machine learning techniques, or computing capability. Just to give an idea about the volumes of data, the Met Office's current operational parallel suites produce about 18 terabytes of data related to the environment every day. What we're really faced with is harnessing the power in that data, and integrating environmental data with data from other systems, such as economic systems, social systems, industrial systems, and operational systems.

We cannot reduce things if we can't measure them. How do we track change and evaluate the effect of policy changes, interventions and adaptation measures if we don't really know what the levels of emissions, air pollution and other environmental factors are? We all agree on this panel that AI can transform our understanding of the complex interactions between ourselves and the environment. What effect do we have on the environment? Looking historically and forecasting into the future, and what effect as the environment have on us in terms of our health and future security?

There are many examples of the use of data, science, and AI to help monitor, track and evaluate inventions and the 10 Sustainable Development Goals (SDGs). The United Nations

Environment Program (UNEP) estimate that around two-thirds of the 93 environmentally related SDG indicators, don't have any data – there is no data to measure them. So how do we track progress towards the SDGs? There's a big data inequality in this, in that many Western countries and increasingly India and China are producing lots of data and information, but that's certainly not true in the case of the global south where there's a real dearth in the information that's available to understand the environment and the changes we need to make.

We've certainly seen lots of examples on how AI can help decision support and risk management, and I think equally as important, if not potentially more important than tracking and monitoring change and measuring the environment, is the integration of AI technologies into energy systems, transport systems, agriculture, and other environmentally related systems. Trying to reduce emissions at source, shall we say, rather than measuring how they're changing over time.

An example that we've been working on in the **Joint Centre for Environmental Intelligence** (JCEEI) with the Alan Turing Institute, is bridging spatial scales. This is looking at using AI to integrate data from multiple sources or very different sources. This might be satellite imagery with ground sensors but also, increasingly non-routine data sources, whether that be social media or small data and how we can use that to downscale climate models. Another example is food security. We're integrating climate projections from the Met Office UK Climate Projections team with crop and disease models. The aim here is to understand how changes in the climate over the next 20 or 30 decades will affect our agriculture in the UK. What are our own condition's going to be like, will we have to change the kind of things we grow, but also looking at the potential for new pests and diseases to affect our agriculture and how we might best deal with those.

There are several examples on how AI can be integrated with the electricity system, in particular with distributed generation through renewables. There are two projects at the moment, which are ongoing. One is energy control room algorithms for decarbonised systems. Here they are using modern AI tools to help decisionmakers in control rooms. There is just so much information now that humans cannot process it all, and so AI can be used to essentially help make decisions, but also to kind of game out potential interventions and changes in a virtual way, and then to assess what that might mean in practice.

Another project, which I think leads on to a very important point, is decision support under climate uncertainty for energy, security, and net-zero. So how are we going to have to change our energy systems with a changing climate? In particular, are our pathways to net zero robust to changes in the environment itself? With renewables, for example, can we look at the potential effects of wind droughts on wind generation? When we have hotter temperatures, for example in the summers which are projected in the UK, what will happen to cooling water, for example in new nuclear power plants? We are looking at the decisions which are being made now and then hopefully, being able to understand how robust they'll be to changes in our climate and our weather over many decades, to inform people and hopefully make investment early and therefore make those investments, more efficient.

One thing I just wanted to mention is the Joint Centre's **'Climate Impacts Mitigation Adaptation and Resilience Framework'** (CLIMAR). Here we are using data science and AI to integrate multiple sources of data. This comes back to the point of taking that environmental data, whether that be the output from complex numerical models of weather and climate and integrating it with data on energy systems. Or, linking into hydrological models to see the effects of flooding in the future, and where areas that potentially haven't experienced flooding in the past might have an increased risk of flooding. Looking at the effects of increased heat in urban areas, we know from The UK Climate Projections 2018, that we can expect hotter and drier summers, when we do get rain, it will be much more intense. Therefore, are our buildings set up for us to work and live at a reasonable temperature? We know that air conditioning buildings on mass is not going to be the answer when it comes to Climate Change, because of the energy usage. What differences or what interventions can we make, what changes to the buildings are possible?

When thinking about this integration of data, climate risks are made up of three components.

- The hazard, which might be increased heat or increased rainfall.
- When we have those hazards, how do they interact with assets or people who are exposed? For example, if there's increased heat in an urban area who is exposed to that heat
- When they are exposed to that hazard how vulnerable are they?

In the case of flooding, if we look at changes in rainfall and we use hydrological models to look at flooding and changes in flooding patterns, which assets are exposed, and if they are exposed to flooding how vulnerable are they and the systems that they are vital components of to that flooding? This is based on the Intergovernmental Panel on Climate Change's (IPCC) risk model, which was developed for disaster risks with this interaction of weather and climate events, with exposure and then when exposed how vulnerable.

I talked about urban heat, we have we working with Bristol City Council, to look at how they might change their building stock, by interventions to reduce heat especially where there are vulnerable people. We have a tool now, that you can change depending on what changes you want to make to buildings and look at the effects on different populations. One of the important things here is to understand whether any inequalities when it comes to the effects of climate are going to be exacerbated over time, or what inventions need to need to be done to mitigate that.

Another one I mentioned, which I think is a very good example of the need for different sectors, different organizations, governments, businesses, academia, public service research enterprises to come together. The **CReDO** climate resilience demonstrator was developed in time just for COP26 last year, and this had the aim of building a digital twin across energy, water and telecoms networks. The idea was to look at climate projections and rainfall with hydrological models, and then look to see what effect that would have on flooding over the coming decades, then crucially, not just where will it flood, but if an electricity substation is flooded, what would be the knock-on effects on the network. We did that in conjunction with

three partners: UK Power Networks, East Anglia Water and BT. One of the real benefits in building these digital twins and using AI and data from different sources is being able to bring together model and model or whole concept of digital twins to see how things might affect and actually look at more than one output at a time.

One of my recommendations is the skills pipeline. I believe there is a great opportunity for the use of AI in helping us solve some of the challenges associated with Climate Change, environmental change, biodiversity loss, and other Sustainability issues, but it does require AI experts. We need people who can manipulate the data and understand models. This doesn't mean that everybody has to have a PhD in AI, but we do need more people who are comfortable and knowledgeable in using these techniques. I'd like to just reiterate the point that we also need those people to have real domain experience, not just technical knowledge on AI and data science, but an understanding of the environment, energy systems and of heavy industry, so that they're not just blindly applying algorithms to a problem that come up with potentially unreasonable results.

My other recommendations include, data accessibility and usability, collaboration and communities between academics, industry, public sector research establishments and government, and finally, scalability and infrastructure.

4. Speaker Bios

Dr. Anand Rao, Global Artificial Intelligence Lead, PWC

Dr. Anand S. Rao is the Global Artificial Intelligence Leader for PwC. He is also the leader of PwC's AI and Emerging Technology practice. With over 35 years of industry and consulting experience, Anand leads a team of practitioners who advise C-level executives and implement advanced analytics and AI-based solutions on a variety of strategic, operational, and ethical use cases. He did his PhD from University of Sydney and his MBA from Melbourne Business School in 1997. He has also co-edited four books on Intelligent Agents and has published over fifty papers in Computer Science and Artificial Intelligence. He serves on the Advisory Board of Oxford University's Institute for Ethics in AI, World Economic Forum's Global AI Council, OECD's Network of Experts on AI (ONE), OECD's AI Compute initiative, and other educational institutions. He was recognized as one of Top 25 Technology Leaders in Consulting and one of the Top 50 Influencers in AI recently.

Aidan O'Sullivan, Associate Professor in Energy & Artificial Intelligence, UCL Energy Institute / Co-Founder, Carbon Re

Aidan O'Sullivan is Associate Professor in Energy and Artificial Intelligence at the UCL Energy Institute and a Turing Fellow at the Alan Turing Institute. He is also Chair for the AI and Climate Change programme at the UNESCO International Research Centre for AI. In 2021 he co-founded Carbon Re a climate tech spin out from UCL and Cambridge University which has

raised £1million in VC funding to decarbonise the manufacture of energy intensive materials like cement and steel using AI.

Diana Dimitrova, Managing Director, Boston Consulting Group

Diana Dimitrova is a Managing Director & Partner at Boston Consulting Group (BCG) and is part of the global leadership team for CO2 AI by BCG. Her work focuses primarily on Sustainability and AI, helping clients across industries tackle their decarbonization journey using the latest technology. CO2 AI by BCG is a patented technology that leverages Artificial Intelligence to allow corporations to measure their carbon emissions comprehensively and accurately at an activity level. AI is further deployed to enable clients in their decision-making process and net-zero roadmap development. Diana has extensive experience from her client work on the challenges related to effective carbon emissions measurement and management, and how technology can help solve key pain points across the entire decarbonization journey.

Pete Clutton-Brock, co-Founder, Centre for AI & Climate

Pete Clutton-Brock's work focusses on the intersection of emerging technology and Climate Change. Pete is a co-founder of the Centre for AI & Climate, where he supports the application of data science and AI to climate-related challenges. He is CEO of Radiance International, an independent climate consultancy where he works with some of the largest tech companies in the world on tech-related climate strategy and delivery. He has in-depth expertise in climate policy and government relations - having worked for the UK Government on national and international climate policy.

Prof. Gavin Shaddick, co-Director, Joint Centre for Excellence in Environmental Intelligence / University of Exeter

Professor Gavin Shaddick is Chair of Data Science and Statistics at the University of Exeter. His research lies at the interface of AI, big data and environmental science. He is the Director of the UKRI funded Centre for Doctoral Training in Environmental Intelligence: Data Science and AI for Sustainable Futures, co-Director of the University of Exeter-Met Office Joint Centre for Excellence in Environmental Intelligence and is an Alan Turing Fellow. He is a member of the UK government's Committee on the Medical Effects of Air Pollutants (COMEAP) and its subgroup on the Quantification of Air Pollution Risks (QUARK). He leads the World Health Organization's (WHO) Data Integration Taskforce, including the development of the WHO's Data Integration for Air Quality (DIMAQ) and its implementation in producing air pollution related Sustainable Development Goals indicators

5. Contact

APPG AI Secretariat

Big Innovation Centre
14-16 Dowgate Hill
London EC4R 2SU
United Kingdom

info@biginnovationcentre.com
www.biginnovationcentre.com

appg@biginnovationcentre.com
https://bicpavilion.com/wall/appg-artificial-intelligence